COMPARATIVE STUDY OF DOUBLE PHOTOTHERAPY (CONVENTIONAL PLUS BILIBLANKET) VERSUS CONVENTIONAL SINGLE PHOTOTHERAPY IN THE MANAGEMENT OF NEONATAL HYPERBILIRUBINEMIA

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Abstract

This is a hospital based prospective study done in Neonatal unit, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from July 2003 to December 2004. The Sample size was ninety in number. They were divided into 2 groups and 45 newborns in each group. The babies who got conventional single phototherapy were taken in group I and babies who got double phototherapy were taken in group II. Each group was again divided into 3 subgroups according to their birth weight (NBW, LBW & VLBW).

Phototherapy is now widely accepted as a safe and effective method for management of neonatal hyperbilirubinemia. Phototherapy detoxifies bilirubin and facilitates its excretion by the kidneys. Biliblanket is a newer phototherapy device, based on fibreoptic units, which delivers high energy green light. Neonatal hyperbilirubinemia in enrolled babies were due to jaundice of prematurity (31%), neonatal sepsis (50%), perinatal asphyxia (10%) and infant of diabetic mother (9%).

Decrement rate of serum bilirubin per day was 2.41±1.20 mg/dl in NBW babies with the use of conventional single phototherapy compared to 4.97±1.05 mg/dl with the use of double phototherapy. In LBW babies, decrement rate of serum bilirubin per day was 2.45±1.9mg/dl with conventional single phtothetherapy but 4.99±0.59mg/dl with double phototherapy. In VLBW babies, decrement rate of serum bilirubin per day was 2.49±0.59mg/dl with conventional single phototherapy but with double phototherapy this decrement rate was 5.21±1.13 mg/dl per day. Double phototherapy was more effective than conventional single phototherapy in all 3 goups of babies. However the rate of fall of bilirubin was higher in VLBW group. This was concluded that decrement rate of serum bilirubin was more than two folds with double phototherapy (conventional plus biliblanket) compared with conventional single phototherapy.

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Introduction

Jaundice is the visible manifestation in skin and sclera of elevated serum concentration of bilirubin. Neonatal jaundice may not appear until the serum bilirubin exceeds 5 to 7 mg/dl[1]. Two third of entirely healthy term newborn and 80% of preterm baby develop jaundice in the first week of life[2].

Though neonatal hyperbilirubinemia is not a major cause of neonatal mortality but its morbidity is observed during the neonatal period, infancy or childhood. Early recognition and proper management is an important aspect of preventive paediatrics. Elevated levels of unconjugated bilirubin have a potentially harmful effect on the central nervous system, especially in the newborn.

The important factors determining such outcome are the level of bilirubin, and duration of hyperblirubinemia. Other factors that contribute to outcome are plasma protein level, hypoxia, acidosis, birth weight and gestatianal age[3].

Treatment of neonatal hyperbilirubinemia is usually based on the measurement of total serum bilirubin (TSB), birth wt. and postnatal age of term and preterm babies[4]. It is recommended to start phototherapy at lower level in preterm low birth wt. and very low birth wt. babies than term normal birth weight babies[5].

Phototherapy is a convenient and safe means of lowering serum bilirubin. Phototherapy reduces the need for the more hazardous exchange transfusion. Phototherapy detoxifies bilirubin and facilitates its

excretion from the body via routes other than conjugation in the liver. There are 3 photochemical reactions viz Photo oxidation, configuration isomerization and structural isomerization. The structural isomer, lumirubin; is currently considered to be the major excretory product of phototherapy[2,6]. Production of lumirubin is directly proportional to the intensity of phototherapy. Fibroptic light source (biliblanket) under the baby and standard overhead lighting device above have been recommended[1,6,7].

The objectives of this study were (1) to find out the decrement rate of serum bilirubin with conventional single phototherapy & double phototherapy (conventional plus biliblanket). (2) To evaluate the efficacy of different modes of phototherapy in term NBW and preterm LBW & VLBW neonates.

Material and methods

It is a hospital based prospective study done in Neonatal unit, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh, from July 2003 to December 2004. The Sample size was ninety in number. They were divided into 2 groups. There were 45 newborns in each group. The babies who got conventional single phototherapy were taken in group I and babies who got double phototherapy were taken in group II. They were matched according to age, sex, birth weight and gestational age of the newborn. Each group was again divided into 3 subgroups according to their birth weight.

Group I a & Group II a (Very low birth weight babies, n= 30), Group I b & Group II b (Low birth weight babies, n = 30) and Group I c & Group II c (Normal birth weight babies, n = 30).

The Inclusion Criteria were Neonatal hyperbilirubinemia due to exaggerated physiological jaundice including preterm, IDM, perinatal asphyxia, and neonatal sepsis. Conjugated hyperbilirubinemia and blood group incompatibility were excluded from this study.

2cc blood was collected from superficial vein. The blood sample was taken in a test tube covered by dark paper and send to the laboratory for serum bilirubin estimation. First sample was done after admission in neonatal unit. Serum bilirubin was measured daily in a patients under phototherapy until it comes down to the level below which phototherapy is no longer required.

On the basis of clinical suspicion of the cause of neonatal jaundice, the following laboratory investigations were done, viz complete blood count, CRP, Coomb's tests, reticulocyte count, blood grouping and Rh typing of mother and baby.

Single or double phototherapy was selected depending upon the availability of phototherapy device in neonatal unit. Selection of double phototherapy preferably given when serum bilirubin in NBW ≥ 16 mg/dl, in LBW ≥ 14 mg/dl and in VLBW ≥ 12 mg/dl. In conventional single phototherapy, 5 fluorescent white tube light of 40 watts with wave length of 450 nm were used at a distance of 45 cms. from body surface. The light irradiance, measured by fluxmeter was 7 μw/cm2/nm, In double phototherapy, biliblanket with high irradiance (35μw/cm^2/nm) used under surface of the body and convention single phototerapy given from above. Halogen bulb in biliblanket and flurorescent whitetube in conventional phototherapy was changed in every 3 monthly for proper efficacy[8].

Results

Out of 90 enrolled newborns, 45 were group I and 45 were group II. The babies who got conventional single phototherapy were taken in group I and babies who got double phototherapy were taken in group II. The distribution of birth weights of enrolled neonates were NBW 20% (group I), 13.3% (group II) and LBW 13.3% (group I), 20% (group II) and VLBW 16.7% (group I), 16.7% (group II), According to gestational age of newborn babies, preterm were 21.10% (group I), 17.80% (group II) and term were 28.90% (group I), 32.20% (group II).

Among 90 babies 28.9% (group I), 24.4% (group II) were male and 21.1% (group I), 25.6% (group II) were female. Male and Female ratio was 1.12:1. Neonatal hyperbilirubinemia was due to jaundice of prematurity (31%), neonatal sepsis (50%), perinatal asphyxia (10%) and infant of diabetic mother (9%) (Fig. 1).

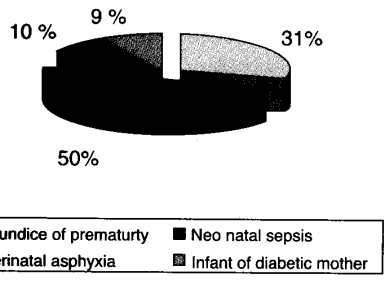

Fig 1 : Hyperbilirubinemia in different conditions in enrolled neonates

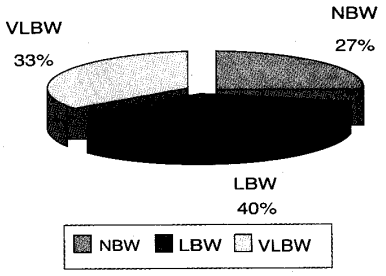

Fig 2 : Single phototherapy group (group I)

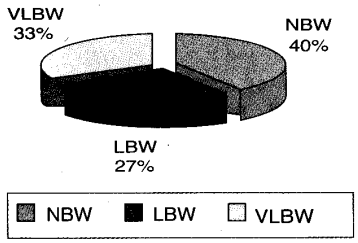

Fig 3 : Double phototherapy group (group II)

Conventional single phototherapy was given in all the 3 groups. They were VLBW (33%), LBW (40%) and NBW (27%) (Fig. 2). In the same manner double phototherapy (conventional plus biliblanket) was given in all the 3 groups, they were VLBW (33%), LBW (27%) and NBW (40%) (Fig. 3).

Table III : Bilirubin levels in NBW babies before and after single & double phototherapy

Phototherapy	S bilirubin (mg/dl)		t/p value (Paired t-test)	Duration (hr)	Decrement/hr (mg/dl)	Decrement/ 24hr (mg/dl)
	Before	After				
Single	16.66±1.47	12.62±1.16	9.34/0.001	32.55±16.21	0.09±0.05	2.41±1.20
Double	19.30±2.09	10.68±1.69	20.0/0.001	43.00±10.94	0.21±0.04	4.97±1.05
t/p value (Unpaired t-test)	3.41/0.002**	1.49/0.147		0.101/0.920	4.22/0.001***	6.91/0.001***

Data are presented as mean±SD. t-test was done as the test of significance. *p<0.05, ***p<0.001

In conventional single photherapy, mean serum bilirubin levels before and after phototherapy were 16.66±1.47 mg/dl and 12.62±1.16 mg/dl respectively. Decrement rate of serum bilirubin per day was 2.41±1.20 mg/dl. In double photherapy, mean serum bilirubin levels before and after phototherapy were 19.30±2.09 mg/dl and 10.68±1.69 mg/dl respectively. Decrement rate of serum bilirubin per day was 4.97±1.05 mg/dl. 't' test was done fore statistieal analysis which was highly significant (p<0.001). The decrement rate of serum bilirubin was higher in double phototherapy.

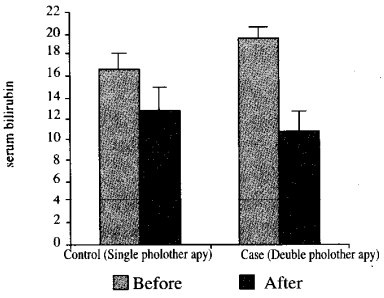

Fig 4 : Bilirubin levels of NBW (normal birth wt) babies before and after phototherapy

Table IV : Bilirubin levels of LBW babies before and after single & double phototherapy

Phototherapy	S bilirubin (mg/dl)		t/p value (Paired t-test)	Duration (hrs)	Decrement/hr (mg/dl)	Decrement/ 24hr (mg/dl)
	Before	After				
Single	13.48±1.54	9.30±0.98	13.20/0.001	39.63±12.69	0.099±0.04	2.45±1.19
Double	17.04±2.16	7.29±1.35	13.85/0.001	55.25±9.27	0.20±0.02	4.99±0.59
t/p value (Unpaired t-test)	3.07/0.005**	0.97/0.341		0.11/0.91	3.25/0.001***	6.99/0.001***

Data are presented as mean±SD. t-test was done as the test of significance. *p<0.05, ***p<0.001

In conventional single phototherapy, mean serum bilirubin levels before and after phototherapy were 13.48±1.34 mg/dl and 9.30±0.98 mg/dl respectively. Decrement rate of serum bilirubin per day was 2.45±1.19 mg/dl. In double phototherapy, mean serum bilirubin levels before and after phototherapy were 17.04±2.16 mg/dl and 7.29±1.35 mg/dl respectively. Decrement rate of serum bilirubin per day was 4.99±0.59 mg/dl. 't' test was done for statistical analysis which was highly significant (p<0.001). Double phototherapy was more effective, with a decrement rate, which was higher.

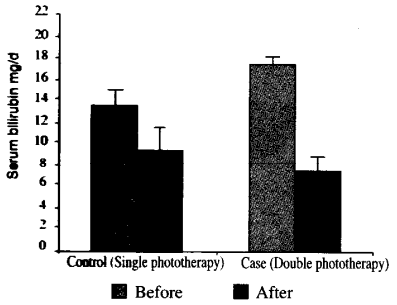

Fig 5 : Bilirubin levels of LBW (Low birth wt) babies before and after phototherapy

Table V : Bilirubin levels of VLBW babies before and after single & double phototherapy

Phototherapy	S bilirubin (mg/dl)		t/p value (Paired t-test)	Duration (hrs)	Decrement/hr (mg/dl)	Decrement/ 24hr (mg/dl)
	Before	After				
Single	14.58±1.71	9.66±1.23	13.33/0.001	49.20±17.30	0.10±0.02	2.49±0.59
Double	15.70±0.76	7.42±0.75	33.39/0.001	41.97±7.45	0.22±0.05	5.21±1.13
t/p value (Unpaired t-test)	2.33/0.027*	4.77/0.001***		1.97/0.058	7.38/0.001***	7.38/0.001***

Data are presented as mean±SD. t-test was done as the test of significance. *p<0.05, ***p<0.001

In conventional single phototherapy, mean serum bilirubin levels before and after phototherapy were 14.58±1.71 mg/dl and after phototherapy were 14.58±1.71 mg/dl and 9.66±1.23 mg/dl respectively. Decrement rate of serum bilirubin per day was 2.49±0.59 mg/dl. In double phototherapy, mean serum bilirubin before and after phototherapy were 15.70±0.76 mg/dl and 7.42±0.75 mg/dl respectively. Decrement rate of serum bilirubin per day was 5.21±1.13 mg/dl. In double phototherapy decrement rate of serum bilirubin was significantly high.

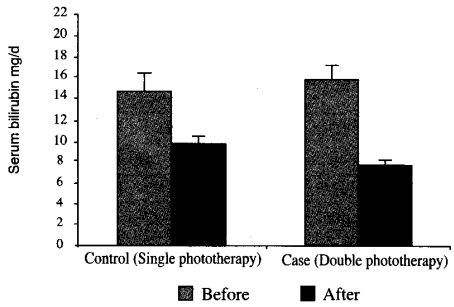

Fig 6 : Bilirubin levels of VLBW (very low birth wt) babies before and after phototherapy

Discussion

This study is designed to compare the effectiveness of double phototherapy versus conventional single phototherapy in the management of neonatal unconjugated hyperbilirubinimia. Most of these newborns with hyperbilirubinemia were within 10 days of age. For conventional phototherapy a distance of 45cm was maintained between the light source & the surface of the babies, in this study. This is similar to the study done by Thor; 20029. In biliblanket we have used high irradiance (35μw/cm2/nm), similar light irradiance was used by Jan et al; (Michigan)10. Biliblanket is an expensive device and therefore its used is limited by high cost in developing countries. It is now used as home phototherapy in United Kingdom, Waslls et al; 200411. Parents preferred biliblanket as it can be used at home with high efficacy.

During double phototherapy only one baby developed rash. Beside this no other side effects were observed during single or double phototherapy which is similar to the study by Maiseles et al; 2003 (USA)12. In this study, decrement rate of serum bilirubin in single phototherapy in term normal birth wt. were 0.09±.05mg/dl/hr and 0.21±.04mg/dl/hr

with double phototherapy. This result is almost similar to the study of Sacrici et al; 200013, they found that the decrement rate of serum bilirubin with double phototherapy was 0.24±.07mg/dl/hr which is similar to this study but the decrement rate with single phototherapy was higher 0.19±0.04mg/dl/hr than this study.

The decrement rate of serum bilirubin in LBW babies in this study was 2.45±1.19mg/dl/24hr in single phototherapy and 4.99±0.59mg/dl/24hr with double phototherapy. Similar type of finding was observed by Kang et al; 199514. The body surface area of LBW & VLBW is greater than normal birth weight babies. Due to the larger surface area of the efficacy of phototherapy is more effective15,16. In VLBW babies decrement rate of serum bilirubin was 2.49±.59mg/dl/24hr with conventional single phototherapy and 5.21±.13mg/dl/24hr with double phototherapy which is consistent with study of Maisels et al; 2003.

Conclusion

Phototherapy is now widely accepted as a safe and effective method for management of neonatal hyperbilirubinemia. Phototherapy detoxifies bilirubin and facilitates its excretion by the kidneys. Biliblanket is a newer phototherapy device, based on fibreoptic units, which delivers high energy green light.

Double phototherapy was more effective than conventional single phototherapy in all 3 goups of babies. However the rate of fall of bilirubin was higher in VLBW group. This was concluded that decrement rate of serum bilirubin was more than two folds with double phototherapy (conventional plus biliblanket) compared with conventional single phototherapy.

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